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AN

ESSAY

ON

Contagious Diſeaſes:

More particularly
On the *Small-Pox*, *Meaſles*,
Putrid, Malignant, and Peſtilential Fevers.

By *Clifton Wintringham*.

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THE

PREFACE.

THE Deſign of this ſmall Treatiſe being to deduce the Cauſes, and explain the Phœnomena *of ſome of the moſt Fatal Diſeaſes which afflict Mankind, can ſtand in Need of no Excuſe, whatever the*

Performance it ſelf may; and eſpecially at a Time, when not only ſeveral of them Rage amongſt us with uncommon Violence, but we are Daily threatned with the dreadful Calamity of a Raging Peſtilence. I have endeavour'd to reduce theſe Diſeaſes to the ſame Simplicity with Others, to ſpeak Intelligibly of them, and ſhow the real Changes in the Animal Oeconomy, from the Principles of the Modern Philoſophy.

The Learned Authors who have already wrote on this Subject, have rejected this Part of it, as being ſo eaſie and obvious as to need no Explanation. I doubt not indeed but this is their Caſe: But how eaſie ſoever it may be to explain theſe Phœnomena, *'tis not every one, converſant in the Practice of Phyſick, that will give himſelf the trouble to deduce them; and 'tis for ſuch chiefly that this ſmall Tract is deſigned; to whom*

whom if it prove any way ſerviceable, I ſhall gain the End I propoſed by it.

York, *June* 1ſt.
1721.

ERRATA.

PAge 8. Line 20. before Contagion inſert *a Peſtilential.* Page 52. Line 17. read *Buboes.*

OF
Contagious Diſeaſes.

CHAP. I.

C*Ontagious Diſeaſes* are generally defin'd by Phyſicians to be ſuch, as are capable of being communicated to us by the Air, or the Effluvia of Morbid Bodies. When the Cauſe producing theſe Diſeaſes is general, and not occaſioned by the peculiar Qualities of particular Places, but brought from Abroad, they are ſtiled *Epidemic.*

The Cauſes therefore of theſe Diſeaſes muſt either be generated in the Air, or produced from the Effluvia of Animal, Vegetable, or Mineral Subſtances floating in it. And conſequently the Effects of the Contagious Particles muſt be extreamly various, according to the Qualities of the Bodies from which they are produced.

When any of theſe Cauſes is of ſo deleterious a Nature, as not only to be Infectious, but to deſtroy all or moſt of thoſe that are affected by it, That Diſeaſe is called a Peſtilence.

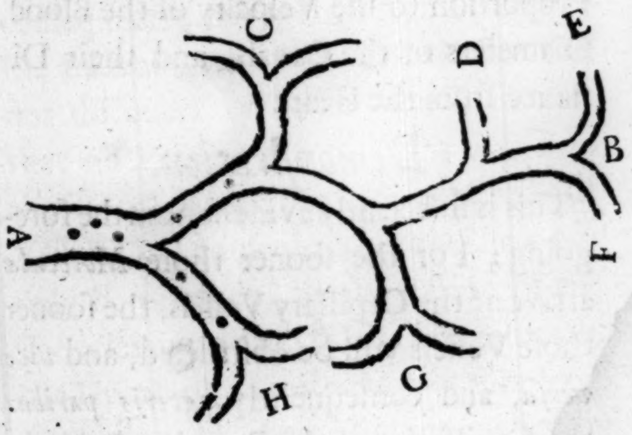
But before I proceed to examine the particular Properties and Effects of the Contagious Particles, it will be Neceſſary to Demonſtrate the following Propoſitions.

PROP. I.

The Magnitude of the Particles of the Blood being increaſed, Obſtructions will be formed in the Ramifications of the ſmaller Veſſels, which will happen ſooner or

or later, in Proportion to the increaſed Magnitude of the Particles, and the ſmallneſs of the Veſſels.

Demonſtration.



Let the Canal A be an Artery of a middle Size, ſending out the Branches C, D, E, F, G, H; Let the Dotts repreſent the increaſed *Moleculæ* of the Blood, it is evident that theſe muſt be ſtopt ſome where or other in the Ramifications of the Veſſels C, D, E, F, G, H, whenever the Diameters of the *Moleculæ* exceed thoſe of the containing Veſſels.

PROP. II.

The Magnitude of the Particles of the Blood being increaſed, thoſe Capillary Veſſels neareſt the Heart will be ſooneſt obſtructed, and *vice verſa*; The reſt in Proportion to the Velocity of the Blood, Diameters of the Canals, and their Diſtance from the Heart.

Demonſtration.

This is ſufficiently evident from the foregoing; For the ſooner thoſe *Molecula* arrive at the Capillary Veſſels, the ſooner thoſe Veſſels will be obſtructed, and *vice verſa*, and conſequently *cæteris paribus* the Capillaries of the Branches C, H, in the preceeding Figure, which are neareſt the Heart, will be ſooner obſtructed than thoſe of E, F.

PROP. III.

The Magnitude of the Particles of the Blood muſt be increaſed either by the Union of a greater Number of them than in a Natural State; Or by the Alteration of their Figure, by which their Surfaces become larger than before.

Demonſtration.

This is evident from the Obſervations of *Lewenhoeck* and *Malpighius* on the perſpirable and other ultimate Veſſels, which are viſible by the Microſcope, and conſequently larger than the Orifices of the Lacteals, which the beſt Glaſſes will not diſcover. Whence it will follow, that no Particle can paſs this way into the Blood, which ſingle can obſtruct the Veſſels, and conſequently this Effect can only be produced by the Action of the Particles upon each other, *viz.* either by the Union of a greater Number, or ſome Alteration in their Figures, whereby their Surfaces become larger than before. Thus the Globules of the Blood as appears by the Microſcope, are nearly of a Spherical Figure, which being the moſt capacious, as well as moſt apt to conſtitute a Fluid Body, by touching in the feweſt Points The farther any Particles deviate from this Figure, the more likely they will be to obſtruct the Veſſels, and *vice verſa.*

PROP. IV.

The Contagious Particles being admitted into the Blood, do there coagulate its Parts, and form *Moleculæ* of a larger Size than ordinary.

Demonſtration.

The Force of the Heart and Cavities of the Canals being the ſame, when the Infection is firſt taken, as before, the Blood would paſs with the ſame Facility thro' the Veſſels as at other Times, and Obſtructions could not be formed, were not the *Moleculæ* thus increaſed; as our Senſes ſhow they are by the Eruption of Puſtules in the Small-Pox, by the great Inflammations, Mortifications, Buboes, and Carbuncles in Malignant and Peſtilential Fevers; and conſequently the Contagious Particles do increaſe the Bulk of ſeveral of the conſtituent Parts of the Blood, by altering the Figures of its Particles, and forming *Moleculæ* of a larger Size than in a Natural State.

CHAP.

CHAP. II.

IT has been the conſtant Obſervation of Phyſicians, as well ancient as modern, and confirm'd by numerous Inſtances, that a hot and moiſt Conſtitution of the Air, joyn'd with ſoutherly Winds, was generally a Fore-runner of malignant and Peſtilential Fevers. Thus *Hippocrates* obſerves, that the Conſtitution of the Air preceeding that malignant Fever deſcrib'd in the 3d Book of his Epidemics, 'was calm, moiſt, and ſoutherly, and ſucceeded a hot, and dry Seaſon; the Winter, calm, cloudy, rainy, warm, ſoutherly; 'ſome Showers, and Northerly Winds 'about the Equinox; the Spring, calm 'and ſoutherly, with great Rains; the 'Summer very hot, with little Wind, and 'much Rain about the Dog-days (*a*). 'Some Authors led by the Title of this

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(a) *Hippoc.* Epidem. lib. 3. ſect. 3. *Galeni* Com. in hunc Loc. *Titi Lucret.* lib. 6.

Book of his Epidemics, *viz.* Κατάστασις Λοιμώδης, or the Peſtilential Conſtitution, have imagin'd the Diſeaſes here ſpoken of, to be the ſame with that terrible Plague deſcrib'd by *Thucydides*, which taking its Riſe in *Æthiopia*, and paſſing thence thro' *Lybia* and *Ægypt*, miſerably haraſs'd all *Perſia*, *Phænicia*, *Judea*, *Greece*, and *Cœle Syria*, and was one of the moſt dreadful Calamities of this kind that ever appeared in the World. But whoſoever will give himſelf the Trouble to compare the Symptoms of the Fevers here deſcribed by *Hippocrates*, with thoſe related by that accurate Hiſtorian (*b*), who both had it himſelf, and viſited many others in it, will find that there is not the leaſt Similitude between them. The one being highly infectious, and not the leaſt Appearance of Contagion in the other: *Galen* alſo the beſt Interpreter of *Hippocrates*, in his Comment on this Book of his Epidemic's ſuſpects, this Title

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(b) *Thucydides* lib. 2.

to be ſpurious, tho' both he and others obſerve much the ſame Conſtitution of the Air to be the Fore-runner of theſe Diſeaſes.

What Places moſt ſubject.

Peſtilential and Malignant Fevers, are likewiſe obſerv'd to be the moſt frequent in thoſe Places where the Climate is hot and ſcorching, and eſpecially when Rains fall in ſuch Seaſons of the Year. Thus in *Ægypt* and ſome other Parts of *Africa*, if Rains fall during the Months of *July* and *Auguſt*, the Plague uſually breaks out the *September* following (*c*).

This is ſtill more remarkable in ſuch Places, as not only are Situated in the forementioned Climate, but are likewiſe deprived of a conſtant Succeſſion of pure and clear Air. An Inſtance of this we have in *Grand Caire*, which beſides being ſubject to the common Diſadvantages of the Country, (as are a Climate hot and ſcorching, a Situation low and

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(c) *Joan. Leon.* Hiſt. *Afric.* lib. 1. cap. 10. *Purchas* Pilgrim. lib. 6. cap. 17. *Athan. Kircheri Scrutin. Peſtis*, pag. 179.

flat, expoſed chiefly to the warm Winds, their Water fetid and ſtagnating, being reſerv'd in Vaults and Canals, which are Annually fill'd by the Overflowing of the River, the Air abounding with putrid Steams and Exhalations, ariſing from the Parts of Animals, Vegetables, and other Subſtances brought down and there 'depoſited by the River), lies cloſe under 'the Hill of the Caſtle, by which all Wind 'and Air is intercepted, which cauſes ſuch 'a ſtifling Heat there, as ingenders many 'Diſeaſes (*d*).

That theſe may juſtly be eſteem'd the Cauſes of the greater Frequency of theſe Diſeaſes in this Place, than others in the ſame Climate, appears from their being ſo rarely known in thoſe Places, which tho' equally hot, enjoy an Air free from Vapours (*e*). Thus in *Numidia* and ſome other Parts of *Africa*, the Plague is ſcarce to be found once in a hundred Years, and hardly at all in the Land of *Negroe* (f).

(d) *Therenot*'s Travels, Part. I. pag. 128.
(e) *Piſo* Hiſt. *Ind.* & *Braſil.*
(f) *Purchas* Pilgrim. lib. 6. cap. 13.

Several Cauſes of the Plague.

The other Obſervations of the Cauſes of theſe Fevers, may be reduced to ſuch as ariſe from the Stinks of ſtagnating Waters in hot and cloſe Weather, to ſome putrid Exhalations of the Earth, to the Parts of Animals and Vegetables putrifying in the open Air, or the taking of corrupt & unwholſome Nouriſhment.

Of the firſt kind was that at *Selinis*, occaſioned by the ſtinking Exhalations of the ſtagnating Waters adjacent, which the diſcerning *Empedocles* removed by ſcouring its Ditches from their Filth, by a freſh Current of Water drawn from two Rivers in the neighbouring Country (*g*).

To the ſecond Claſs may be reduced that Peſtilential Fever, which the ſame great Philoſopher check'd at *Agrigentum*, by ſtopping the Mouths of ſome neighbouring Mountains, whoſe pernicious Fumes had infected the adjacent Country (*h*); As alſo that mentioned by *Ammi-*

(g) *Plutarchi* Lib. περὶ πολυπραγμοσύνης.
(h) *Diog. Laert.* in Vit. Emped.

anus Marcellinus, which broke out in *Seleucia*, and over-ran a great Part of *Greece*, *Italy*, and *Parthia*, and took its Riſe from the opening of an old Vault in the Temple of *Apollo*.

To the Third belong, ſuch as are occaſioned by the Parts of Vegetables and Animals, eſpecially thoſe of Men, putrifying in the open Air. As was that mention'd by *Livy*, which over-ran a great Part of *Italy*, and owed its Riſe to the dead Bodies of the *Romans* and *Fidenates* left unburied in the Field of Battle (*i*). Analogous to this was that which from the ſame Cauſe appeared in *Germany*, *Anno* 1630; And likewiſe that mentioned by *Ambroſe Parree* from the ſame Cauſe; as alſo that mentioned by *Diodorus Siculus*, occaſioned by great Quantities of Locuſts driven by Winds into the Sea, and thence caſt up in Heaps on the Shore. To this likewiſe muſt be reduced thoſe Malignant and Peſtilential

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(i) *Tit. Livii* Hiſt. *Roman.*

Fevers, which ſo frequently attend Camps and Seiges, eſpecially in the hot Eaſtern Countries, whoſe numerous Armies frequently feel the diſmal Effects of theſe ſtinking Fumes: As do likewiſe the vaſt Caravans of the *Mahometans* in their Annual Pilgrimages to *Mecca*.

To the laſt belong thoſe Peſtilential Fevers, which take their Riſe from a preceeding Famine, as was that in *Judea* in the time of *Herod* (k), in which the Product of the Ground being conſumed by the great Heat, and long Drought of the preceeding Summer, the pooreſt ſort of People were obliged, thro' the Scarcity of Proviſions, to make uſe of ſuch Food as afforded unwholeſome and putrifying Juices.

(k) *Joſeph.* Antiq. *Judæor.* lib. 15. cap. 12.

CHAP.

CHAP. III.

THE Changes wrought in the Animal Oeconomy from the above-mention'd Cauſes, may be reduced to ſuch as depend either on the Increaſed Heat of the Air join'd with its Humidity; Or to ſuch as are produced from the particular Qualities of the putrid and Contagious Particles floating in it; Or to the united and complicated Effects of all together.

Effects of a hot and moiſt Air.

The Alterations produced in the Body from a greater Heat continually ſurrounding it, provided it be not Exceſſive, are a Rarefaction of the Juices, and Relaxation of the *Fibres* on the Surface of the Body, and greater Derivation of the Fluids that way. Whence proceeds a large Evacuation of the perſpirable Matter. This being continued in a greater Proportion than in a Natural State, will gradually deprive the Blood of its Aqueous and Spirituous Parts, and leave the remaining ſerous Part more ſtock'd with acrid and pungent Salts, and the Groſs, Terreſtrious, Oleaginous, and Viſcous Particles more firmly united by their nearer Approach, and ſtronger Coheſion to each other. This greater Heat or Quantity of Fiery Particles, continually ſurrounding the Body, will neceſſarily inſinuate it ſelf into, and unite with the Saline, Sulphureous, and other Particles, in the ſame manner as we ſee it does with other Subſtances, both Solid and Liquid (*l*); And likewiſe by increaſing the Velocity of the Circulation and Attrition of the Particles againſt each other, render them on theſe Accounts alſo more Volatile, Pungent and Stimulating, and conſequently the Blood will conſiſt of Particles more groſs and inſpiſſated or coagulated, and likewiſe of thoſe of a more acrid and pungent Diſpoſition than in a natural State.

(l) *Boyl's* Experm. Nov. de Pond. Ignis & Flam. *Newtoni* Optic. Quæſt. 21 & 22.

The Blood being in this depraved Condition, the reſt of the Animal Juices muſt degenerate in Proportion thereto, and the Nervous Fluid, as it conſiſts of the moſt volatil and ſubtil Parts, be extreamly acrid and pungent, as well as unequal in its Texture and Fluidity, from the more viſcous Parts contain'd in it.

Putrid Fevers how produced.

This then being the State of the Blood and other Juices of the Body, it is eaſy to perceive how from very Slight, and otherwiſe trivial Occaſions, a Fever of a very Malignant Nature may be produced. Thus the perſpirable Matter from a ſlight Cold taken being retained, or the Veſſels any otherwiſe filled by Irregularities in Diet, or others of the Non-naturals, the Weight of the moving Fluid will be increaſed, and the Circulation be more languid and ſlow. Whence the inteſtine Motion of the Particles of the Blood being diminiſhed, the viſcous Parts will cohere more ſtrongly and in greater Quantities than before, and obſtruct the Capillary Arteries, eſpecially in the Extremities, and a Coldneſs, Stretching, Yawning, Torpor, *&c.* neceſſarily ſucceed, the conſtant Attendants of a beginning Fever; All which will bear a Proportion to the Quantity retain'd, and the Viſcoſity of the moving Fluid.

Theſe Diſorders will neceſſarily be increaſed on account of the Air's Spring being weakned by its Heat, the Veſſels of the Lungs being leſs inflated, and the Globules of the Blood leſs broken and divided, and the more eſpecially in a humid Air, Heat and Moiſture neceſſarily relaxing the Tone of the Fibres and Veſſels, and rendring them leſs Springy and Elaſtic. Hence then the Quantity of Spirits being diminiſh'd, and their Motion more ſlow, the Contraction of the Heart and other Muſcles will be more weak and languid, and being ſtimulated by the Acrimony of the Circulating Liquors, muſt contract more frequently than in a Natural State; The Conſequence of which is Weakneſs, Faintneſs, Thirſt, and Dejection of Spirits.

Theſe and the preceeding Symptoms will neceſſarily continue, 'til ſuch time as the groſs and viſcous Matter, being ſhook and looſen'd by the Action of the Capillary Veſſels, is waſhed away into the Veins by the force of the Circulating Fluids, and there continues its Courſe with the reſt, 'til it be either attenuated and ſecreted, or lodged again in the Capillaries to excite new Diſorders.

Malignant Fevers. Now if to this evil Diſpoſition of the Air be added a number of pungent ſtimulating Particles, whether bred in the Body or floating in the Air, and thereby communicated to the Blood, which are apt to coagulate the Animal Juices, ſo as to form *Moleculæ* of ſuch Shapes and Sizes as more firmly obſtruct the Capillary Veſſels, and at the ſame time ſtimulate and corrode the nervous Parts; It will neceſſarily happen, that the preceeding Symptoms muſt be highly exaſperated, and a Fever of a much worſe Nature produc'd.

Hence then muſt follow a violent Hurry and Colluctation of the Fluids, the Viſcid and coagulated Parts of the Blood in ſome Parts obſtructing the Circulation of the Juices, and the Acrid, Volatil, and Fiery Parts, rarefying and diſſolving others of the more Liquid, to the greateſt degree of Pungency and Volatility imaginable.

Hence it is eaſy to perceive how the Motion of the Blood muſt neceſſarily be in ſome Parts more languid, by the Cohesion of the more Viſcous parts, in others quicker, join'd with a pungent and ſtimulating heat, from the increaſed Velocity and Acrimony of the moving Fluid, and the various Actions of the Particles upon each other, and their Impulſes on the containing Veſſels; As alſo how theſe are capable of almoſt infinite Variations, in Proportion to the different Quantities and Qualities of the conſtituent Particles. Hence then appears the Reaſon of that wandering and uncertain Heat and Coldneſs, in different Parts of the Body at the ſame time. Hence appears the Reaſon of that great Inquietude and Anxiety, of thoſe uncertain and partial Sweats, Watchings, Tremors, ſtretching Pains of the head, and the like, as will be more fully ſhown hereafter.

But before I proceed to explain the Nature of a Fever truly Peſtilential, it will be neceſſary to obſerve, that notwithſtanding the foremention'd putrid Diſpoſition be generally a Prelude to a Peſtilential Conſtitution of the Air, yet it has never that I know of been obſerv'd, that theſe Cauſes alone at their firſt Onſet, produced a real Plague or Peſtilential Contagion, without the Concurrence of ſome preceeding Infection, either brought from abroad, or gradually augmented from the increaſed Putrifaction of the Air, and Poiſonous Steams of Morbid Bodies.

Thus the putrid Air of Camps in hot Countries is frequently found to produce Peſtilential Fevers, but this never happens at their firſt Onſet; The Diſeaſes firſt appearing being Fluxes, Putrid, and afterwards Malignant Fevers; which being exaſperated and propagated by the Virulent Effluvia of Diſeaſed Bodies, and the increaſed Putrifaction of the Air, grow up gradually to thoſe of a Peſtilential, and exceedingly infectious Diſpoſition.

Of Putrifaction & Fermentation.

Now Putrifaction being only a kind of Fermentation, wherein the Particles of a putrifying Body are put into an inteſtine Motion, and by their Action and Attrition broken and divided, and ſince all fermenting Subſtances do emit vaſt Quantities of ſmall ſeparable Parts, it will neceſſarily follow, that the moſt ſubtil and active Particles of the Putrifying Body will be elevated into the Air, and float in it.

Effluvia from putrified Bodies what.

Theſe Effluvia conſiſt of the fineſt and moſt volatil ſaline and oleaginous Particles, highly attenuated and ſet at Liberty from the groſs Oil and Terreſtrious Part, as appears from the Diſtillation of ſuch Subſtances, all which afford great Quantities of a pungent and volatil Salt. It is likewiſe obſervable, that the ſubtil Oleaginous Particles being ſpecifically lighter, as well as more eaſily attenuated and divided than thoſe of a Saline Nature, will be thrown off in greater Proportion in the beginning of the Fermentation or Putrifaction than the heavier Salts will be, which muſt either be more attenuated and volatiliſed, or require a greater force to raiſe them into, and ſuſtain them in the Air than the former, and conſequently the greateſt Emiſſion of theſe ſaline Particles will be after the Fermentation has been for ſome time continued; As we find it happens in all fermenting Liquors, as Wine, Beer, Cyder, and the like. All which emit, during the Fermentation, greater Quantities of Particles of an active attenuated Oil or Spirit for ſome time, than of a Saline Nature, which requiring a longer time in order to attenuate them, are not raiſed till the former are in a manner quite exhaled, as appears from collecting the Steams of fermenting Liquors, and of thoſe which are turn'd ſower by Diſtillation, and conſequently the Exhalations ariſing from putrifying Bodies will after ſome time conſiſt moſtly of Saline Particles highly attenuated and volatiliſed, and thoſe not wrapt up and ſheathed in the Oily ones, and thereby render'd innocuous, and often uſeful to the Body, but naked and exceedingly acrid and poignant.

How unfit an Air ſtock'd with theſe kind of Particles is for Reſpiration, appears from ſeveral of Mr. *Boyl*'s Experiments on Animals, ſhut up with putrified Air in the Receiver, moſt of which with incredible Inquietude die ſooner than in *Vacuo*, as alſo from the pernicious Effects of the Steams of Vaults, Mines, the *Grotto de Cane*, and ſuch like. But beſides this Inaptitude of ſuch Air to expand the Pulmonary Veſſels, theſe minute and pungent Particles may be conſidered as ſo many *Stimuli* or Lancets, acting upon and penetrating the Coats of the Stomach, Lungs, and other Veſſels. On which Account they are not only capable of creating great Diſordes, as Inflamation, Pain, Sickneſs, Anxiety, Vomiting, *&c.* in the Stomach and Nervous Parts; But likewiſe being carried immediately into the Blood, will there ſtimulate the ultimate Veſſels, ferment, diſſolve, or coagulate the circulating Juices according to the particular Qualities and Quantity of the Contagious Particles. Nor is it unlikely, that from the various Action of the Particles upon each other, and their different Combinations in a ſtagnating Air, Particles may be formed of Qualities vaſtly differing from, and in their Force almoſt infinitely exceeding thoſe of their Primogenial Salts and firſt Principles, as in Sublimate, ſome Preparations of Antimony, *&c.* Inſtances of which thoſe verſed in Chymiſtry are no Strangers to.

Infectious Particles how produced.

Now ſuppoſing the Blood Saturated with theſe kind of Particles, and a Malignant Fever produced by their means, we all know that the Blood in this State throws off vaſt Quantities of ſubtil and active Particles thro' the Perſpirable, Salival, and other Excretory Ducts of the Body, which not only muſt load the adjoining Air with great Quantities of them, and render it capable of producing more diſmal Effects than the preceeding, but alſo the Particles thus thrown off muſt be endued with a more acrid and pungent Diſpoſition than the former, inaſmuch as they are more ſubtily divided and attenuated by the Force of the Fever, than thoſe in the preceeding Diſpoſition of the Air, where ſo powerful an Agent was wanting, And conſequently produce a Fever of a moſt infectious and deleterious Nature; And eſpecially when the Infection is taken toward the latter end of the Diſeaſe, at which time the Saline Particles will be more exalted and volatiliſed, as well as thrown off in greater Quantities, and thereby made more capable of producing an infectious Contagion.

For the Blood in theſe Circumſtances may not unaptly be compared, as was before hinted, to a fermenting Liquor, whoſe Parts being conſtantly in Motion, are continually throwing off great Quantities of ſubtil and active Spirits, capable of exciting the ſame Fermentation, and producing the ſame Qualities in thoſe of the like Species, as appears from our manner of fermenting Ale, Beer, *&c.* with Yeaſt, which is a Spirituous Ferment, and alſo from the Sower Ferments uſed in making Vinegar, *&c.*

Analogous to this we may obſerve, that the Blood in different Diſeaſes, as well as different Animals, throws off great Quantities of active Particles, which when mixed with the Blood of a Healthful Perſon, are capable of exciting the ſame Fermentation and Diſorder in the Animal Juices, with thoſe of the Morbid Animal from which they exhale, as we find in the *Small-Pox*, *Meaſles*, *Saliva* of a *Mad-dog*, and the like.

This then being the Diſpoſition of the Blood and other Juices, in thoſe Fevers which we call Peſtilential, it is evident, that whatever the particular Subſtance of the Contagious Particles may be, they muſt be endued with ſuch Qualities as will Coagulate the Animal Juices, Stimulate the *Fibres* to frequent Vibrations, cauſe Obſtructions in the Capillary Veſſels, and render the Blood and other Juices of the Body exceedingly Acrid and Pungent, as appears from hence and the foregoing Propoſitions; The Symptoms and Conſequences (*cæteris paribus*) being the ſame, whether the Diſeaſe has gradually grown up to this Height, or took its Riſe only from Contagious Particles brought from abroad.

How propagated.

This is the Method by which I ſuppoſe theſe Contagious and Peſtilential Particles to be firſt generated and produced, in thoſe places which are moſt ſubject to them, and thence propagated firſt into the Neighbourhood, and afterwards to greater Diſtances by way of Intercourſe and Commerce. The Peſtilential *Effluvia* being pack'd up and conveyed in Goods of a ſoft and looſe Texture, as Silk, Wool, Cotton, and the like; And ſo much the more eaſily, as the Air into which theſe infected Materials are brought, is prediſpoſed to act in full Concert with them; as happens in all Places at ſome times more than others; At which time if theſe infectious Particles be communicated, they exert their Rage with the utmoſt Violence, but frequently are either diſſipated and loſt, or produce Diſeaſes of leſs fatal Conſequence, in an oppoſite Diſpoſition of the Air.

Why the Plague ceaſes. Thus hard Froſt, ſtrong cold and Northerly Winds, are found frequently to put an End to, or at leaſt bridle the Fury of Contagious Diſeaſes, and render them more mild and curable, as was obſervable in the Beginning of the laſt great Plague in *London* (m), and frequently taken Notice of in other Places by the

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(m) *Hodges* de Peſte.

Writers on this Subject. Conſonant to this we find in *Ægypt*, that the Riſing of the *Nile* by giving a freſh Motion to, and altering the Diſpoſition of their ſtagnating and putrid Air, by the mild Vapours and Nitrous Exhalations (*n*) iſſuing from it, immediately checks the Raging of the Plague, and reduces it to a Fever of a more mild and curable Nature; inſomuch that as *Purchas* and others inform us, if there die in *Grand Caire* 500 Perſons of the Plague the Day before, yet upon the Increaſe of the River it ceaſes to be Peſtilential, and none die of it (*o*). And indeed it can hardly be imagin'd, how the Plague when it has once got eſtabliſh'd in any Place, ſhou'd ceaſe but with the Deſtruction of all or moſt of the Inhabitants, was it not checked by ſome Alteration in the Diſpoſition of the Air, and gradually reduced to a Fever of a more mild and curable Diſpoſition.

(n) *Boyle*'s determ. Nat. Effluv. cap. 4. *Plot*'s Nat. Hiſt. of *Staffordſh*. cap. 2. pag. 42.

(o) *Purchas* Pilgrim. lib. 6. cap. 7. *Sandy*'s Travels, lib. 2. cap. 97.

It will I think be needleſs to ſhow, that the Diſtempers here treated on are propagated by Contagion; But it may not be altogether unneceſſary to explain by what Methods theſe Alterations in the Animal Oeconomy are brought about, and eſpecially as the Means by which they are chiefly communicated, have not that I know of been fully examin'd.

CHAP. IV.

Of a Peſtilence by Contagion.

THE Contagious Particles whether they be generated in the Air, or produced by the *Effluvia* of Morbid Bodies, being ſuſtain'd in it, are thereby applied to the Surface of our Bodies, with a Force equal to the Preſſure of the Incumbent Atmoſphere. This Preſſure upon the External Superficies of a human Body of a middle Size, has been demonſtrated to be equal to 39900 Pounds Troy-weight, and conſequently ſuppoſing the Body in every Part encompaſſed with theſe Particles, the whole Force with which all theſe Particles are on this Account propell'd into the Body, will amount to the aforeſaid Sum. But every ſingle Particle is only applied with the Force of a Column of Air of the Height of the Atmoſphere, and whoſe Baſe is equal to the Surface of that Side of the intruding Particle, oppoſite to the cutting Angle. Now the Contagious Particles from their extream Smallneſs and pungent Angles, may not only be conſider'd as Bodies applied to us with the preceeding Force, but likewiſe as ſo many ſmall Knives or Lancets, acting upon and penetrating the Coats of the Lungs and Surface of our Bodies, with a Force proportional to the Smallneſs of their cutting Angles. This appears not only from ſeveral Propoſitions in Mechanics, but even to our Senſes, by the ſtrong Contraction of a Cord or Fiddle-ſtring in moiſt Weather. The Particles of Water from their exceeding Smallneſs, being protruded into the Cord, with a Force capable of Raiſing the greateſt Weights. Now if to theſe be likewiſe added the ſtrong attractive force of theſe ſmall Volatil Particles, occaſioned from their Exiguity, it will be no difficult matter to conceive, that they are capable of penetrating the Veſſels of our Bodies. Thus the Attractive Force of the Magnet is greater in Proportion to its Bulk, in Small ones, than in thoſe of a larger Size, from the greater Proximity of all its Particles to each other. And 'tis on this Account that Sir *Iſaac Newton* computes the Attractive Force of the Particles of Light, to be to that of other Bodies, as 1000000000000000 to 1, in Proportion to the Quantity of Matter contain'd in them (*p*).

This I think is ſufficient to ſhew, that theſe Acrid and Pungent Particles are able to penetrate the Surface of our Bodies, and get into the Blood that way; And indeed Experience it ſelf confirms it in all other Pungent and Acrid Sub-

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(*p*) Optic. in fine Queſt. 22.

ſtances, as *Garlic*, *Cantharides*, *Arſenic*, and all *Pungent* and *Corroding* Bodies.

The Preſſure of the Air on the Internal Surface of the Lungs in Breathing determined.

But tho' the whole Superficies of our Bodies are Penetrable by theſe Poiſonous Particles, yet the principal Miſchief is communicated to the Blood in its Paſſage thro' the Lungs. For conſidering the prodigious Number of the Pulmonary Veſicles, into all which the Air enters in Reſpiration, and likewiſe the vaſt Increaſe of their Surfaces on that Account, and alſo the greater Force by which theſe Particles are applied to the Internal Surfaces of the Veſicles in Expiration, in Proportion to that whereby they are applied to other Parts of the Body of equal Superficies; it will evidently appear, that the Contagion is chiefly communicated by theſe Veſſels to the Blood. For it appears by the Barometer, that every Inch Square upon the Surface of our Bodies is preſſed upon by a Weight nearly equal to 1800 Drams, when the Mercury ſtands higheſt in the Barometer. Now ſuppoſing with Dr.

Kiel (q) that both the Lobes of our Lungs contain 226 ſolid Inches, of which only $\frac{1}{3}$ or 75 Inches are Veſicles. Suppoſing alſo the Diameter of a Veſicle to be $\frac{1}{50}$ Part of an Inch, the Surface of the Veſicle will be .001256 and the Solidity .0000043, by which if we divide 75 the Space fill'd by the Veſicles, the Quotient, *viz.* 17441860 X .001256 the Surface of a Veſicle, gives the Sum of the Surfaces of all the Veſicles, = 21906.976 ſquare Inches. Which Sum being multiplied by 1800, the Number of Drams which every ſquare Inch of the Surface of our Bodies ſuſtains, gives the Weight which the whole Internal Surface of the Lungs ſuſtains by the ſole Preſſure of the Atmoſphere, when the Mercury ſtands higheſt in the Barometer, equal to 39442556.800 Drams, equal to 410859.966 + $\frac{64}{96}$ lib. *Troy* weight, as appears from the known Laws of *Hydroſtaticks* (r).

Now if to this be added the increaſed

(q) Animal Secret. (r) *Marriote's* Hydroſtaticks.

Preſſure of the Air, againſt the internal Surfaces of the Veſicles in Expiration, the Force will be found to be ſtill greater. For ſuppoſing the Diameter of the *Larynx* to be equal to 0.5 of an Inch; Suppoſing alſo the Preſſure of the *Larynx* in an ordinary Expiration, by which the Force of the expired Air exceeds the Preſſure of the Atmoſphere, to be two Ounces, as has been found by Experiment (*s*), the Preſſure of the Air in an ordinary Expiration upon the Internal Surface of the Veſicles of the Lungs, will on this Account only be equal to 1844736 Drams, or 19216 lib. *Troy* weight, which added to the Preſſure on the Veſicles by the Weight of the Atmoſphere, amounts to 39444401.536 Drams, or $410879.182 + \frac{64}{96}$ Pounds *Troy* weight. But the Preſſure of the Air on all the reſt of the Surface of our Bodies amounts but to 39900 lib. *Troy*, which is to the Preſſure upon the Internal Surface of the Lungs, as 1 to $10.297 + \frac{28882}{39900}$,

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(s) *Kiel's* Animal Secretion, *Edit. ult.*

and conſequently many more of the Contagious Particles will be communicated this way, than thro' the whole Surface of the reſt of the Body. The Weights aforemention'd are indeed prodigious, but that is cauſed by the great Increaſe of Surface by the Number of the Veſicles: For it is ſtill to be conſider'd, that the Preſſure upon each ſquare Inch of the Surface of theſe Veſicles, amounts to no more than the Preſſure on every Inch Square on the Surface of our Bodies, except that Increaſe which is made by the Force of Expiration, otherwiſe theſe Veſicles cou'd in no wiſe withſtand ſo prodigious a Preſſure. This Quantity, *viz.* 75 Cubic Inches or thereabouts ſeems to be emitted from the Lungs in an ordinary Expiration, for I have found by Experiment, that the Lungs in a large Expiration will emit above 160 Cubic Inches of Air. Having my ſelf fill'd an exhauſted Receiver of that Size with Air at one Expiration, of the ſame Denſity with that of the Atmoſphere.

Now if we likewiſe conſider the exceeding Smallneſs of the Pulmonary Veſſels, and alſo that the whole Quantity of Blood in the Body muſt neceſſarily paſs this Organ, in order to its being attenuated and made fit for Circulation; It will neceſſarily follow, that the Alterations made in the Texture of the Blood by the Poiſonous *Effluvia*, are communicated to it chiefly thro' this Organ. Beſides, the Poiſonous Particles do not only Enter into the Blood in greater Quantities in this Bowel, but when carried by theſe Paſſages, are capable of doing much more Miſchief, than if entring in at any other Part of the Body, in Regard that they are more intimately mixt with it in its Comminution. I have inſiſted the more largely on this Argument, becauſe I find that moſt who have wrote in this Subject, tho' they do ſuppoſe ſome of the Contagious Particles may be communicated to the Blood this way, yet lay the greateſt Streſs on the Mixture of theſe Particles with the *Saliva*,

liva, which being ſwallowed carries them in common with our Nouriſhment. 'Tis not Improbable indeed, that many of theſe Particles may be this way communicated to the Blood; but it is as Probable, that many of them which are by this way Communicated, loſe much of their Force by their Mixture with the *Bile* and other Juices; As we ſee happens in the Poiſon of the *Viper*, which taken at the Mouth is not deadly, but when mixed immediately with the Blood produces the moſt violent Symptoms. The ſame may be obſerved from many other Subſtances, which may be ſafely taken into the Body by the common Paſſages, as moſt Acids, Spirit of Wine, and other Subſtances, but when mixed immediately with the Blood, by Injections into the Veſſels of living Animals, produce Coagulations, Convulſions, and Death: The principal Reaſon which has induced Phyſicians to ſuppoſe, that the Poiſonous *Effluvia* are chiefly communicated by theſe Paſſages, are thoſe violent Vomitings which frequently accompany it; But this happens equally in many other Fevers, where there cannot be the leaſt Suſpicion of Contagion. The only Objection to what I have here advanced ſeems to be, That if the Contagion was communicated to the Blood chiefly by the Lungs, the Coagulations wou'd be immediately form'd there, and this Bowel totally obſtructed. But if we conſider, that the Chief Application of the Air to the Pulmonary Veſicles is in Expiration, immediately after which the Blood enters the *Vena Arterioſa*, whoſe Branches continually grow wider, and give Space and Time for the Coagulating Particles to act with their full Force, this Objection will of it ſelf fall to the Ground.

The Contagious Particles being by theſe Means got into the Blood, do there by Coagulating and Inſpiſſating the more groſs and tenacious Parts, and highly Volatiliſing and Attenuating others of the moſt Subtil, reduce the Blood into the above-mentioned State. Thus we ſee that *Milk*, which is the Juice of an Animal, by the Addition of a ſmall Quantity of an Acid Spirit, changes from an equal Texture, to one of a more groſs and viſcous, as well as more fluid and watry Subſtance. The like may be obſerved in the White of an Egg and the Blood of an Animal it ſelf. Analogous to this is that Experiment of *Jo. Bapt. Alprunus*, who examining the Matter of a Peſtilential *Bubo* by Diſtillation, found at firſt a *Phlegm*, then a more fat and oily Matter, and laſtly a Salt aſcending into the Neck of the *Retort*. But what was the moſt Remarkable in this Experiment, was the prodigious Stench upon opening the Veſſels, exceeding as he expreſſes it a Thouſand Wounds expoſed to the Summer's Heat, and likewiſe a Salt ſo exceedingly Acrid and Pungent, as to equal, if not exceed *Aq. Regis* it ſelf (*s*).

I ſhall not from hence pretend to determine, that an Acid Salt is the imme-

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(*s*) *Ph. Col.* No. II. p. 17.

diate Inſtrument of theſe Changes in the Animal Oeconomy, ſince the ſame may be wrought by Spirit of Wine, and other Liquids (*t*); and Experience aſſures us, that the *Effluvia* proceeding from the putrifying Parts of Animal Bodies, abound with a Volatil Alcaline Salt, as appears by Collecting them by the Bell, or in Diſtillation, by which they afford ſome Phlegm, a moſt Fetid Oil, and exceedingly Pungent and Volatil Salt; But this is ſufficiently Evident from what has been ſaid, that whatever the determinate Nature of the particular Particles may be, they do not only Coagulate the Animal Juices, and increaſe the Bulk of the Particles of the Blood, but render the remaining Part exceedingly Acrid and Pungent.

Conſonant to this Dr. *Hodges* has obſerved a great Affinity between a Peſtilential and Scorbutic Habit of Body, and that thoſe whoſe Blood naturally

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(t) *Boyl's* Hiſt. Humani Sang. *Friend's* Emonalogia in Fine.

abounded with Saline Particles, and had the reſt Coagulated or Inſpiſſated, as happens in Scorbutic Conſtitutions, were more grievouſly affected by the Peſtilence; and alſo that moſt of thoſe who Recover'd of the late Plague, were very much ſubject to Scorbutic Diſeaſes: The like I have frequently obſerved, where the Small-Pox, Meaſles, *&c.* ſeizes thoſe of a Scorbutic Habit.

Nor is the Blood alone affected by its Mixture with theſe Saline *Spiculæ*, but the reſt of the Animal Juices alſo in Proportion, and eſpecially the Nervous Fluid, which conſiſting of the moſt fine Volatil and Subtil Parts, will be render'd extreamly Acrid and Pungent: Whence Pain, Sickneſs, Inflammations, *&c.* muſt neceſſarily ſucceed.

CHAP.

CHAP. V.

THE Symptoms accompanying a Peſtilential Fever are Yawning, Stretching, Coldneſs, frequently to the greateſt Extremity, Shuddering, ſuddain Pains in the Head, Giddineſs, Loathing, Vomiting, a low unequal Pulſe, Trembling, great inward Heat, eſpecially about the *Præcordia*, Coldneſs of the Extremities, uncertain Sweats, Inquietude, Stupor, Delirium, Watching, Convulſions, Carbuncles, Buboes, Livid Veſications, Purple Spots, *Hæmorrhages*, which three laſt are the certain Forerunners of Death.

But here it is to be obſerved, that all the preceeding Symptoms do not conſtantly happen to every individual Perſon who is affected with a Peſtilential Fever, but differ both in Number and Degree according to the Degree of Infection, Virulence of the Contagious

Particles, and Conſtitutions of particular Perſons; Thus the more the Blood is ſtock'd with Acrid and Pungent Salts, and other Parts render'd Glutinous, Coagulated, or Inſpiſſated, the hotter the Seaſon of the Year, the more violent the Symptoms will be, where the Degree of Infection is equal, and *vice verſa.*

Yawning, Stretching Laſſitude.

Theſe are the firſt Signs of the Seiſure of the fatal Enemy, and take their Riſe from the Slowneſs of the Motion of the Circulating Fluids. For the Viſcoſity of the moving Fluids being increaſed, and the *Liquidum Nervorum* degenerating in Proportion thereto, the Weight to be moved will bear a greater Proportion to the moving Force than in a Natural State, and conſequently the Animal muſt be affected with Wearineſs, as we find it is in all Caſes where the Spirits are exhauſted and weakned, in Proportion to the Circulating Juices. The other two are the neceſſary Conſequence of this, for the Viſcoſity of the Fluids rendring them unfit to paſs the ſmall Capillary

Veſſels, the Preſſure on the *Fibres* and Veſſels will be increaſed, excite an uneaſy Senſation, and ſtimulate them to more frequent Vibrations, in order to diſlodge the Enemy: Whence follows a Contraction of the Muſcles, and eſpecially thoſe which ſerve for Voluntary Motion, and into which the Spirits are moſt frequently determin'd: Hence then appears the Neceſſity of ſuch a Method and Medicines as may dilute and diſſolve the Cohering Fluids, and eſpecially of ſuch as are taken actually hot, and with large Quantities of Diluters, the great Activity of the Fiery Particles contain'd in them, rendring them much more capable of penetrating into the ſmalleſt Receſſes of the Body, and disjoining the Coagulated Fluids.

Coldneſs, Shuddering.

Theſe likewiſe depend on the too great Coheſion of the ſanguineous Particles, on which account the Circulatory as well as the Motion of the inteſtine Particles of the Blood being diminiſh'd, and many of the Igneous Particles intangled in the viſcous Co-

Coheſions, a Senſation of Cold muſt neceſſarily enſue, and eſpecially in thoſe Parts where the Motion of the Blood is moſt ſlow, and its Coheſion increaſed as happens in the Extremities. The nervous Juice being likewiſe for the ſame reaſon determin'd Irregularly, and in leſs Quantity into the Muſcles, ſometimes one, ſometimes another of them will be weakly contracted, or a Shuddering will enſue.

A Low, quick, unequal Pulſe.

Theſe ariſe from the Secretion of a ſmaller Quantity of Animal Spirits, and thoſe too unfit to actuate the Heart and other Muſcles, whence their Contractions will be more weak, and being ſtimulated by the Acrimony of the Juices more frequent than in a Natural State. The Derivation likewiſe of the Nervous Fluid into the *Fibres* of the Heart being irregular, for the Reaſons afore-given, the Motion of the Heart, and conſequently of the Pulſe, muſt be weak, quick, and unequal.

Theſe are occaſion'd partly by the Contagious Particles being drawn in with the Breath, and in their Paſſage tainting the *Saliva*, which when ſwallowed Irritates the Nervous Filaments of the Stomach, and partly by the Secretion of a more Pungent and Acrid Matter by its Glandulous Coat; as appears from their ſpontaneous Ceaſing as ſoon as a Sweat can be procured, and the Diſcharge of theſe Acrid Particles promoted by the Perſpirable Glands (*u*), and ſeldom otherwiſe. *Loathing, Vomiting.*

A *Diarrhæa* is likewiſe oftentimes a Concomitant of theſe Fevers, and ever of moſt dangerous Conſequence in the Beginning of the Diſeaſe, inaſmuch as it exhauſts the Strength of the Patient, and prevents the regular Expulſion of the Perſpirable Matter, by which Experience aſſures us that theſe Contagious Particles are moſt effectually diſcharg'd. Theſe then indicate ſuch Medicines as cleanſe the *Primæ Viæ* from the Conta- *Diarrhæa.*

(u) *Sydenham* de Peſte.

gious Particles, and other Crudities lodged in them, blunt the Acrimony of the Saline Particles, and promote the Regular Expulſion of the Perſpirable Matter.

Coldneſs of the Extremities.

This is occaſion'd by the weak Contraction of the Heart, and greater Viſcoſity of the Blood in the Extream Parts of the Body, for the Circulating Fluids being preſt on every Side by the containing Veſſels, the more thin and liquid Part will paſs into ſuch Veſſels as ariſe neareſt the Heart, and leave the reſt more Viſcous and unfit for Motion. The Force of the Heart in the extream Parts being alſo much diminiſh'd, thro' the numerous Ramifications of the Veſſels, the Motion of the Blood will be more ſlow, the Coheſion of the Particles of the Blood greater, and the Obſtructions in the Capillaries more fixt than in other Parts of the Body. Now the Heat of the Body depending in a great Meaſure on the Attrition of the Particles againſt each other, this being diminiſh'd in the Extream Parts of the Body, the other muſt be leſſen'd in Proportion.

Great inward Heat eſpecially about the Præcordia.

This is occaſion'd by the greater Inteſtine Motion and Colluctation of the Particles of the Blood, and the Expanſive Particles of Heat being in greater Proportion in theſe than other Parts of the Body, from the more numerous Ramifications and Obſtructions of the Veſſels, and their Proximity to the Heart, as appears by *Prop.* 2.

Inquietude Watching.

Theſe ariſe from the ſame Cauſe as the Preceeding, the great inward Heat being a conſtant *Stimulus* to the nervous Parts, and obliging the Sick to ſeek continual Change of Place and Poſture, in order to abate this uneaſy Senſation. Theſe therefore indicate the uſe of ſuch Medicines as ſpecifically correct the Acrid and Stimulating Particles, reſtrain the inordinate Efferveſcence of the Circulating Fluids, and attenuate the Viſcous Coheſions, of which kind are diluting and attenuating Acids, temperate Cordials and Anodynes, in ſuch Doſes and Proportions as are agreeable to the Age, Strength, and other Circumſtances of the Patient.

Delirium. This ariſes from the Inordinate Influx of the *Liquidum Nervorum*, occaſioned from its Acrimony, Viſcoſity, and Quantity, different from thoſe in a healthful State. Whence the Reflux of the Spirits to the Brain will be altogether irregular, and the Repreſentations brought by them Irrational and Inconſiſtent. As this Symptom may ariſe as well from the increaſed as leſſen'd Quantity, and different Texture of the Fluids, and Springyneſs of the Solids; ſo Regard muſt be had to the particular State of the Solids and Fluids in every Individual, for the abating of this Symptom.

Stupor. This Symptom neceſſarily ſuppoſes the Flux of the Spirits thro' the Brain and Nerves in ſome Meaſure intercepted or diminiſhed, and conſequently as the preceeding may ariſe from different and even contrary Cauſes, but generally in theſe Caſes ſhews a greater Degree of Coagulation in the Juices than the former,

mer, and conſequently of greater Danger from the more numerous Obſtructions in the Capillary and Nervous Veſſels. Agreeable to which is that Obſervation of Dr. *Hodges*, That they who were attended with this Symptom rarely recover'd.

Trembling, Faultering in the Speech.

Theſe depend on the ſame Cauſe as the former, *viz.* On the Diminution or Obſtruction of the *Liquidum Nervorum*, whereby the Muſcles are involuntarily and weakly contracted. As theſe ſuppoſe a more torpid Motion and greater Viſcoſity of the Fluids, and leſs Degree of Elaſticity in the ſolid Parts, ſo the Method taken herein ought to be more active and ſtimulating than in any of the foregoing Symptoms. Whence Epiſpaſticks, and the moſt Volatil Attenuating Medicines are more neceſſarily required, and ought to be oftner repeated, than in preceeding Symptoms.

Pain in the Head.

This is Occaſioned by the Obſtruction of ſome of the Capillary Veſſels of the Brain by the Coagulated

Part of the Blood, and the wounding of the Nervous Filaments by the Poiſonous Saline *Spiculæ*. Whence the Blood being reſiſted in its Motion, muſt preſs more ſtrongly againſt the Sides of the Veſſels, and diſtend them beyond their Natural Diameters, and produce a ſhooting and throbbing Pain; and if the Obſtruction continue or increaſe, a Phrenſy, Inflammation, Suppuration, and Gangreen of the Part affected. Why this Symptom ſhould be one of the firſt, as well as a conſtant Attendant thro' the whole Courſe of the Diſeaſe, appears from *Prop.* 2.

Carbuncles, Buboes, &c. Hence likewiſe appears the Reaſon of Carbuncles, Boboes, Veſications, and the like, which take their Riſe from the ſame Cauſe, and are different only in Proportion to the Viſcoſity or Acrimony of the obſtructing Matter, and the Situation and Structure of the Part affected.

Purple Spots, Hemorrahges and These ſhow the greateſt Corroſion and Acrimony imaginable in the Circulating Fluids, ſo as to be able to break and deſtroy the very Veſſels themſelves, and conſequently certain Signs of a ſpeedy Diſſolution of the whole Animal Oeconomy.

Diſſections of ſuch as have died of Malignant and Peſtilential diſeaſes.

The Diſſections of ſuch as have died of theſe Diſeaſes are a farther Confirmation of the foregoing Theory, inaſmuch as they demonſtrate a greater Acrimony and Coagulation in the Juices than other Diſeaſes, by the numerous Obſtructions Inflammations, and Mortifications of different Parts of the Body. Thus the Stomach and Inteſtines are commonly highly Inflamed, and frequently Gangreen'd. The Lungs, Diaphragm, and ſeveral of the *Viſcera* inflamed, obſtructed, and beſet with Carbuncles and Purple Spots. The Arteries of the *Dura* and *Pia Mater* obſtructed, and ſtuff'd with Grumous Blood, and often mortified. The Arteries of the whole Body in general fuller than ordinary, the Veins more empty. The Veſſels about *Præcordia* much obſtructed, highly inflamed, and often Gangreen'd. The membranous Parts of the Body in general more dry and rigid than in moſt other Diſeaſes.

CHAP. VI.

Of the SMALL-POX.

FROM what has been ſaid of the Nature of Malignant and Peſtilential Diſeaſes it will follow, that the Contagious Matter producing the Small-Pox does likewiſe Coagulate the Blood, and increaſe the Bulk of its conſtituent Particles, and that in ſuch a Proportion as are capable of obſtructing only the ultimate and perſpirable Veſſels, as appears, in that it principally, if not ſolely affects the membranous Parts of the Body, as well External as Internal. Now theſe Parts being formed of ſuch Veſſels, the Puſtules could not happen in theſe more than other Parts of the Body, were not their Veſſels thus obſtructed, and obſtructed they cou'd not be, but from the increaſed Bulk of the Sanguineous Particles, and that in ſuch a Proportion as renders them capable of penetrating into, but not paſſing thro' the Cavities of the ultimate Veſſels, as appears from the preceeding Propoſitions, and conſequently, the contagious Matter producing the Small-Pox, muſt be indued with this peculiar Property. And indeed if we allow the different Degrees of Coagulation in theſe Contagious Diſeaſes, and which appear even to our Senſes, it will appear, that the Principal if not the ſole Difference proceeds only from the greater or leſs Bulk and Number of the Coagulated *Moleculæ*, and Acrimony of the Coagulating Matter. Thus we ſee that in Peſtilential Diſeaſes, where the Degree of Coagulation and Acrimony of the Juices are ſuperior to the reſt, the Obſtructions happen in the larger Glands, as are thoſe of the Armpits, Groin, *&c.* The Circulation of the Blood being obſtructed, or at leſt much retarded in the Capillary Blood Veſſels, as appears from the weak Pulſe, Coldneſs of the Extremities, and the like, which conſtantly accompany it; And conſequently the *Moleculæ* form'd by the Coagulation of the Animal Juices muſt be larger, than theſe in the Small Pox, which proceed to the ultimate Veſſels before the Obſtructions are formed. The *Meaſles* are another Confirmation of this Theory, whoſe *Moleculæ* are ſtill leſs than the preceeding, as appears by their Eruption with greater Flatneſs, and leſs Extenſion of the Obſtructed Veſſels. Thus alſo we ſee that in all theſe Diſeaſes where the Contagious Matter is more Virulent than ordinary, or the Conſtitution of the Year more productive of theſe Diſeaſes, or join'd with a Hot Tenſe and Scorbutic Diſpoſition, Diarrhea's, Dyſenteries, Purple Spots, Hemorrhages, Phrenſies, Convulſions, Inflammations, *&c.* equally accompany theſe as Peſtilential Diſeaſes.

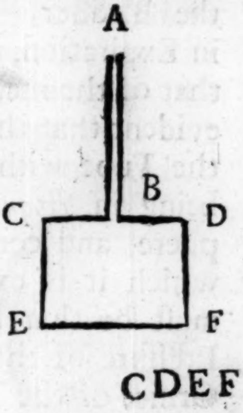
From what has been ſaid in this and the foregoing Chapters may be deduced the Reaſons of the greater or leſs Virulency of the Small-Pox, Meaſles, *&c.* in ſome Years more than others; As alſo why theſe Diſeaſes ſhou'd rage with the greateſt Violence when join'd with, or immediately preceeding a Peſtilential Conſtitution of the Air. Hence alſo appears the Reaſon why Pains of the Head, Stomach, Loins and Back, preceed the Eruption of the Puſtules, theſe Parts as neareſt the Heart being ſooneſt obſtructed, and the *Impetus* of the Blood againſt the obſtructed Canals much greater than in the reſt of the Body. As alſo why the Puſtules ſhould appear ſo much ſooner in the Face, Neck and Breaſt, than other Parts of the Body, as appears from *Prop.* 2.

Hence likewiſe appears the Reaſon why the Fever, Vomiting, Pains, *&c.* preceeding the Eruption of the Puſtules ſhould ceaſe or be much diminiſh'd upon their Appearance; The *Moleculæ*, by the Force of the Circulating Fluids, being driven into and fixt in the Cutaneous Glands, and Secretory Veſſels, whereby the Capillary Arteries being freed from them, a more eaſy Paſſage is allowed to the Circulating Fluids. Hence alſo appears the Reaſon why the Fever gradually increaſes with the Augmentation of the Puſtules, the Contiguous Veſſels being compreſs'd by their Diſtention, and the Obſtructions in the Secretory Veſſels made more Numerous; whence the Quantity of the Perſpirable Matter being Diminiſhed, and the Canals ſtreightned, the Veſſels will be more full, and the Pulſe more ſtrong and frequent. Hence likewiſe it will follow, that the more numerous the Obſtructions are, and more pungent the Contagious Matter, the more Violent the Symptoms will be, and the Matter of the Puſtules when ſuppurated become an Acrid and pungent gleety Subſtance, or Laudable *Pus*. As alſo why the Time of Suppuration ſhou'd vary in Proportion to the Virulency of the obſtructing Matter; and conſequently the Reaſon of the Difference between the *Diſtinct* and *Confluent Small-Pox*. Hence alſo it will appear, that Bleeding, in the Beginning of the Diſeaſe, ought only to be Adminiſtred where the *Impetus* of the Circulating Fluids is ſo great, that notwithſtanding the Diminution of the Force of the Blood by it, the protruſive Force of the Circulating Maſs will exceed the *Impetus* made on the Obſtructing Matter by the Vibrations of the *Fibres*, and likewiſe why on its imprudent Uſe in the Beginning of the Diſeaſe, the Puſtules ſhou'd diſappear, and be driven back into the ſanguineous Veſſels. Hence alſo may be deduced the Reaſon of the Flux by the Salival Glands, the Swelling of the Face, Hands, and Feet, in the height of the Diſeaſe, the Veſſels being at this time Turgid by the Suppreſſion of the perſpirable Matter ; And likewiſe the Neceſſity of ſuch Evacuations, as may reduce the Preſſure of the Fluids upon them to ſuch a Proportion, as the Tone of the *Fibres* may be able to reſiſt ; And why where this is neglected, a *Peripneumonia*, Phrenſy, Delirium, *&c.* do frequently ſucceed.

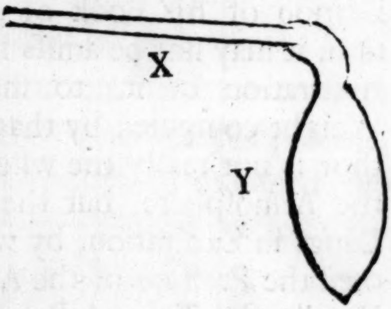
Laſtly, Hence may be deduced the Reaſon why the Small-Pox ſhou'd rarely ſeize thoſe twice, who have had a Competent Number of them. For the Ultimate Perſpirable Veſſels being diſtended much beyond their Natural Tone, by the Bulk of the Obſtructing *Moleculæ*, the Secretory Veſſels muſt be left wider than before, and conſequently leſs ſubject to be obſtructed by Particles of this Size; Agreeable to this is that Obſervation of Dr. *Sydenham* and others, That in thoſe Conſtitutions of the Air where the Small-Pox were very *Epidemic*, many (eſpecially ſuch as attended the Sick) who before had been affected with this Diſeaſe, were ſeized with a Fever in all Reſpects the ſame with that attending the Small-Pox, except only the Eruption of the Puſtules, and the Symptoms which neceſſarily attend on them.

THE APPENDIX.

THE Preſſure of the Atmoſphere on the internal Surface of the Lungs, as computed in the foregoing Pages, ſo much exceeding that made by the ingenious Dr. *Kiel*, in the laſt Edition of his Book of Animal Secretion, it may not be amiſs for the farther Illuſtration of it, to ſhow that the Weight computed by that Learned Author is not really the whole Preſſure of the Atmoſphere, but the Force of the Lungs in Expiration, by which they exceed the Preſſure of the Air upon them. For let the Tube A B be inſerted into the Veſſel C D E F of any given Dimenſion, and both the Tube and Veſſel fill'd with Water or any other Fluid, it is evident from the Writers in Hydroſtatics, that the Veſſel



CDEF will be preſſed upon on every Part of its Internal Surface equal to the Baſis of the Tube, by the Weight of a Column of the contained Fluid of the ſame Height with the Fluid, and whoſe Baſe is equal to that of the Tube, and conſequently every Inch Square on the Internal Surface of the Lungs will be preſſed upon by a Column of Air, whoſe Height is equal to that of the Atmoſphere, and baſe one Inch Square, which will amount to the aforeſaid Sum. *Vide Pag.* 34 & 35.



Now if we ſuppoſe the Tube X inſerted into the Neck of the Bladder Y and the Air forced into the Bladder in Expiration, to an equal Denſity with that of the incumbent Atmoſphere, it is evident that the Air will not go out by the Tube without ſome external Force, being in *Æquilibrio* with the Atmoſphere, and conſequently the Force by which it is expreſſed thro' the Tube, muſt be that by which it exceeds the Preſſure of the Atmoſphere, upon the Orifice of the Tube.

If any one think that I have allowed too large a Quantity of Air to be taken into the Lungs in an Ordinary Inſpiration, That is ſufficiently recompenſed by ſuppoſing the Diameter of the *Larynx* equal to 0.5 and its Orifice 0.19 which is more than it can be, for the Diameter does not exceed 0.4, and conſequently its Orifice will be but 0.12. Now it being demonſtrated by the Writers in Hydroſtatics, that Weights forcing equal Quantities of the ſame Fluid out of the ſame Orifice, are to each other as the Squares of the Times in which the Fluid is forced out, and that in equal Times and Quantities of the ſame Fluid forced thro' unequal Orifices, the weights are Reciprocally as the Orifices; The Powers forcing an equal Quantity of Air thro' the Orifices 0.19 and 0.12 muſt be to each other in a Reciprocal Proportion, compounded of the Squares of the Times and Orifices of the Tubes; Which will be found ſufficient to anſwer any Objection of this kind, by any who will give himſelf the Trouble to compute it.

FINIS.

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